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TOWARD IMPLEMENTABLE AAF-SAP MODEL-TYPES FOR AFRICAN COUNTRIES: Some Preliminary Specifications

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INTRODUCTION

The African Alternative Framework to Structural Adjustment Programmes for Socio-Economic Recovery and Transformation (AAF-SAP) was adopted by the African Ministers of Finance and ministers responsible for Economic Planning and Development at their joint meeting on 10 April in Addis Ababa, Ethiopia. AAF-SAP made a number of proposals including a general formalized framework for use in the formulation of models to analyse policies.

However, it was explicitly noted in AAF-SAP that in the general formalization of the framework presented therein it was "not meant to provide economic models that could be applied across the board to all African countries. Such modelling exercise is to be carried out for each individual country on the basis of its particular circumstances"[1] (emphasis added). As such what was presented in AAF-SAP was merely a general frame of reference covering three broad areas that were believed essential in modelling AAF-SAP. These areas were (a) the production structures, (b) income distribution and (c) expenditure patterns. In identifying these three broad areas AAF-SAP did not imply that all AAF-SAP models had to be compartmentalized in these three modules but rather that models that would be developed in the context of AAF-SAP should always try to cover aspects of these three broad areas.

In the present paper a number and variety of model-types are presented and discussed. These models are taken within the general context of AAF-SAP which emphasis the structural aspects of adjustment and thereby aims at achieving adjustment with transformation.

As will be seen, even the small model-types presented in Part I are such that they can address the structural implications of policy options in specific areas such as inflation or debt and growth. With such an approach policy-makers can be guided even by these very simple model-types as to the possible implications of a variety of policy instruments and measures.

In Part II a more elaborate model type of adjustment with transformation is presented. This model-type aims at tracing the long-term objectives and implications and limits of alternative transformation paths, as well as the desirable policy instruments and measures. Such a model-type can, no doubt, prove useful in helping policy-makers to make choices of policies at the various stages and directions of transformation.

Of course, due to the holistic approach that is implicit in AAF-SAP, the general formalization of the framework constitutes a skeleton variant of a general equilibrium model. As such, it would ideally be best to develop a comprehensive general equilibrium model-type capable of analyzing the adjustment and structural policy concerns of AAF-SAP. However, a number of factors dictate that the movement towards such a comprehensive model-type has to be taken carefully in the African context. Issues such as data availability, the nature and functioning of transmission mechanisms, the understanding of different closures in the African situation etc. all require time to study and call for caution in modelling the African socio-economy. Indeed, it is more than apparent that an AAF-SAP general equilibrium model for an African country should result from a stage-by-stage elaboration and testing of equations and hypothesis over a period of time. I.e.

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1 See Annex 1 of The African Alternative Framework to Structural Adjustment Programmes for Socio-Economic Recovery and Transformation E/CA/CM.15/6/Rev.3

the model should evolve in the country over time. This, however, does not invalidate the proposed formalized framework of AAF-SAP. Actually it is with this in mind that Part III of the present paper outlines specific considerations that are assumed important in the elaboration of a general equilibrium model-type both consistent with AAF-SAP and likely to be implementable and useful in African countries.[2]

2 Some African countries, such as Egypt, have already evolved comprehensive models that could very usefully serve as a basis for an AAF-SAP general equilibrium model.

PART I. SMALL MODEL-TYPES ADDRESSING SPECIFIC PROBLEMS

In this part some small model-types are presented to illustrate how specific issues relating to structural adjustment policy analysis can be approached. Such problem-oriented model-types have been successfully applied in Latin American countries and have on many occasions, proved to be of great practical use when compared with large general equilibrium models that are merely imported from outside or in textbooks. Because of their small size and inherent flexibility, these small model-types are easily manipulable to the specific conditions of a given country and do not require massive data. Further, although the model-types are small and simple, they can nevertheless offer very useful insights into adjustment and structural issues. The two small model-types presented in this part relate separately to the specific problems of:

(a) Inflationary pressures
(b) Debt and growth

1.1 Small Model-Type for Analyzing Inflation Pressures[3]

The model-type for the analysis of inflationary pressures is structural in the sense that it takes price formation as opposed to monetary variables as the basis of the analysis. Below is the outline of the model-type and how it can be applied in African countries.

(a) The basic Price formation model-type.

Cost price formation is taken to depend on the following elements: wages, costs of intermediate inputs (domestic and imported), costs of capital and changes in overall productivity.

Thus we have:

$$1a.\ p_t = \alpha_1 w_t + \alpha_2 m_t + \alpha_3 u_t - e_t$$

Where p = cost price level
w = wage rate
m = cost of intermediate inputs
u = other non-wage and non-input component of value added (e.g. profits and indirect taxes on output)
e = sum of changes in the productivity of different factor inputs.

and $\alpha_1 + \alpha_2 + \alpha_3 = 1$

considering different productivity changes for each component in price formation equation 1a can be rewritten as:

$$1b.\ p_t = \alpha_1 (w_t - e_t^{\,w}) + \alpha_2 (m_t - e_t^{\,m}) + \alpha_3 (u_t - e_t^{\,u})$$

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3 Lance Taylor gives a slight variant of the inflation model-type presented here which incorporates the concept of capacity utilisation (an important structural characteristic in African countries) and its possible effects on inflation. See for example Lace Taylor, "Macro Policy in the Tropics: How sensible people stand" in World Development, Volume 15, Number 12. Special Issue, December 1987 and/or "Structuralist Macro-economics", New York: Basic Books, 1983.

(b) Analysis of different sources of inflation on basis of the price formation equation

The different elements on which the price formation equation 1 is based result in inflation pressures in a variety of ways. These different transmission mechanisms can include, for example, wage indexation or mark-ups. Thus we could have the following formulations.

$$2a.\quad W_t = \beta_1 P_{t-1}$$
$$2b.\quad m_t = p_t^f + \sigma E R_t$$
$$2c.\quad \sigma E R_t = \beta_2 P_{t-1}$$
$$2d.\quad \mu_t = \beta_3 (P_t + r_t)$$

where P_t^f = external price of imported intermediate inputs.
$\sigma E R_t$ = exchange rate changes with σ giving devaluation/revaluation rates
r_t = changes in the mark-ups and indirect taxes

With some simple algebraic manipulation, after substituting equations 2a to 2d in equation 1a the price equation can be expressed as:

$$3a.\quad P_t = [(\alpha_1\beta_1 + \alpha_2\beta_2)/(1-\alpha_3\beta_3)]P_{t-1} + [(\alpha_2 m_t)/(1-\alpha_3\beta_3)] + [(\alpha_3\beta_3)/(1-\alpha_3\beta_3)]r_t - [(1)/(1-\alpha_3\beta_3)]\varepsilon_t$$

If, as is often the case, we assume that $\beta_3 = 1$[4] then we have the following price equation.

$$3b.\quad P_t = [(\alpha_1\beta_1 + \alpha_2\beta_2)/(1-\alpha_3)]P_{t-1} + [(\alpha_2)/(1-\alpha_3)]P_t^f + [(\alpha_3)/(1-\alpha_3)]r_t - [(1)/(1-\alpha_3)]\varepsilon_t$$

As can be easily deciphered from the last price formation equation 3b, four main components emerge and these can be further explored in the context of the unique nature of the inflation pressures in a given country and context. These four components are:

(i) Effects of past domestic inflation and the resultant price inertia.
(ii) Effects due to imports of intermediate including import tariff rates and due to devaluation of domestic currency.
(iii) Effects due to monopolistic/oligopolistic structures in price formation, subsidies and indirect taxation policies.
(iv) Effects due to changes in productivity.

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4 In many cases, and especially in Africa, this is likely to be true since mark-ups and indirect taxes are often if not always passed on to the consumer in terms of increased prices. An interesting case would be where β_3 is assumed to be greater than 1 to account for the phenomenon of a single product being repeatedly traded through many middlemen (each one with an additional mark-up) usually outside permissible limits of mark-up levels. This is particularly true in situations of acute shortages of goods and a large parallel market for goods.

(c) Data requirements

The above simple model-type requires only limited statistical data. Parameters α_1, α_2, and α_3 can always be obtained from the proportions of gross output and the wages, return to capital and intermediate inputs.

(d) Possible applications of the model-type in the context of AAF-SAP

It is easy to envisage that the above small-model type can be expanded for African countries to assess the implications of a number of policy instruments individually or collectively. In the context of AAF-SAP, the policy instruments that can be analyzed as regards their implications on inflation include:

- subsidies changes to production units;
- changes in world prices of certain imported inputs e.g. fuel;
- changes in domestic prices of imported inputs (i.e. trade policies such as trade liberalization and different tariff rates);
- price decontrols and letting mark-ups find their own level;
- effects of exchange rate, overall devaluation.

(v) Some limitations of the inflation model-type and possible guides

In the spirit of the formalised framework of AAF-SAP which aims at tracing interactions among the structure of production, the income distribution patterns and the levels of the satisfaction of needs, the inflation model-type outlined above has certain limitations which should be explicitly acknowledged. Firstly, it does not explicitly incorporate the aspect of income distribution. However, this could be partially remedied by certain assumptions about the destination of specific factor incomes (eg. wages to workers, mark-ups to rent-seekers and indirect taxes to government). In this remedial approach analysis of different policies can incorporate aspects of income distribution effects.

Secondly, the model-type does not again explicitly relate the pressures of inflation to the satisfaction of the needs of the different income groups. It is well known that inflation affects different income groups differently and as such, it would be desirable to relate the price-formation inflation model-type to the effects inflation has on the satisfaction of essential needs - goods and services. Fortunately, with some on-the-side work differentiating products along the line of the outlined inflation model-type, it would be feasible to incorporate certain aspects (e.g. affordability) of the satisfaction of society's essential needs.

Thirdly, it is difficult to apply the model alone from formation paths since its main policy parameters and their interactions do not easily lend themselves to an analysis of transformation implications in the long-run. Perhaps only in the context of diversification (eg. reducing imports of intermediate inputs) could the above model-type guide policy makers on the questions of the possible inflationary effects and the alternative policy options.

1.2 Small Model-Type for Analyzing Debt and Growth

The small definitionally-derived model below can facilitate alternative scenarios relating to overall economic performance and the effects of export price changes as well as scenarios for debt and debt rescheduling. The model is derived as below.

(a) Balance of payments definition: Using the standard balance of payments definition we have

1. $X-M-INT+F+\delta D-\delta R=0$

where

X = total export earnings
M = total import bill
INT = scheduled debt servicing
F = inflow of transfers
δD = net increase in debt stock
δR = changes in reserves

Assuming that[5]

$F = 0$
$\delta R = 0$

Then we have from equation 1,

2a. $X-M-INT+\delta D=0$
2b. $\delta D = INT+M-X$

Dividing through by the total debt-stock we have

3. $d = \{(\delta D)/(D)\} = \{(INT)/(D)\} + \{(M)/(D)\} - \{(X)/(D)\}$

Equation 3 can be conveniently rewritten as

4. $d = i + Y/D\{(M/Y)-(X/Y)\}$

$= i + y\{(M/Y)-(X/Y)\}$

where the following interpretation applies

d = relative increase in indebtedness
i = effective interest rate paid on existent debt stock
y = ratio of GDP to debt stock

$\{(M/Y),(X/Y)\}$ = import and export ratios

Y = GDP

(b) Analysis of debt and growth scenarios

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5 These first assumptions can be justified on the basis that any grants inflow will go to certain projects and corrections for its growth impact can be treated separately. The second assumption is justified on the basis that during very acute balance of payments disequilibria there is little room for financing of BOP using changes in reserves.

The small model-type definitionally derived in equation 4 can be used to analyze some scenarios such as:

The increase in debt to achieve a given growth

A policy rate of growth in GDP can be set for variable Y. With this rate the import ratio (M/Y) derived using import elasticities and the possible export ratio can be derived through appropriate formulation of equations that link export growth with overall growth. The variable of effective interest rates paid on existent capital stock can be estimated from historical debt-repayment data or from prevailing interest rate levels and, from these the relative increase in debt stock can be derived.

Export targets: In such a scenario, the relative increase in debt stock can be taken as an exogenous parameter (either from a policy to limit debt expansion or from an estimation on basis of credit-worthiness and the international financial environment). Similarly the effective interest payment rate can be exogenously determined while the import ratio is determined from historical import elasticities. This would enable the determination of the export ratio as a residual and with specific growth targets, of GDP, export targets can easily be derived.

Debt Rescheduling: Scenarios of desirable rescheduling could also be analyzed on the basis of export earning possibilities
(incorporating hypotheses on export commodity prices), import requirements and the resultant effective interest payments that can or cannot be paid.

(c) Data requirements: As can be judged from the above sketch of scenarios that can be analyzed, the data requirements of the debt/growth model type are indeed minimal and should be manageable for most African countries with adequate historical and current data on their debt levels and repayments.

(d) Applications of the debt/growth model-type in the context of AAF-SAP:

In the context of AAF-SAP the following issues and policy instruments can be analyzed in relation to the problem of debt:

- limitation of debt service ratios to levels consistent with sustaining and accelerating growth and development; desirable negotiated rescheduling;
- specific export incentives for processed exports and carefully-selected primary commodities;
- differential export subsidies, removal of trade barriers and encouraging barter trade;
- bilateral and multilateral agreements on primary commodities.

(e) Extension of debt/growth model-type to domestic absorption

Due to the ex-post identity from national accounts of the trade gap and the savings gap, the debt/growth model-type outlined above can be analyzed from the perspective of domestic absorption as follows:

Given that I-S=M-X,
We can substitute for (M/Y)-(X/Y) in equation 4 and get

5. $d = i+(Y/D)(K-S)$

where K = (I/Y) = investment rate

S = (S/Y) = savings rate

Also in this simple domestic absorption formulation a number of scenarios can be analyzed such as required saving rates, limiting of capital flight, implication of different incremental capital output ratios etc.

PART II. EXTENDED INPUT-OUTPUT MODEL-TYPE FOR AAF-SAP ANALYSIS

2.1 Overview of the relationship of the extended input-output type to AAF-SAP.

The object of the exercise is to find a model suitable and practical enough to assist African planners and policy makers with regard to the total impact of policies that are being devised to help remove the structural stagnation of the economies of most African states which have generally produced one or two primary commodities for export to foreign countries and the export earnings have been diverted to bring imported goods from abroad. Such dependence of the entire economy to one or two export commodities with small domestic activity for local consumption has not however succeeded in either making local industries grow or eliminating the poverty of the mass of people or maintaining stable or sustainable balance of payment positions.

In this part, a short-term operational framework for an AAF-SAP model-type is presented. The model-type is in a straightforward input-output framework with the difference that certain coefficients or some components may be changed while others are technically fixed in the short run. Coefficients may be changed according to an independent assessment and anticipation about levels of productivity, prices, income elasticities etc.

The model-type incoporates the way the structures of production and income are linked through consumption and earnings.[6] While generally dealing with fixed coefficient it has been demonstrated that adjustment may be made in the coefficient for income elasticities and productivity parameters.

The model-type is based broadly on the extended input-output matrix with fixed coefficients for both production and consumption by different classes in relation to their respective income. In this way the model integrates all the aspects together. The major points in the proposed model-type are as follows: (i) exports by sectors are taken as a proportion of total output and this proportion may be changed as a matter of diversification policy; (ii) competitive and non-competitive imports form a sum of a constant input-coefficient related to production with the understanding that the constant component (competitive) may be changed by import-substitution policy; (iii) for simplification investment is supposed to flow from factors directly and not channelled through institutions;[7] and, (iv) the capital imports are related to the sectors concerned and can be taken as policy parameters on one hand and as fixed by needs of maintenance on the other.

2.2 Presentation of the model-type

Symbolically the model-type can be represented as follows:

$$X_i = \Sigma_j a^{pij} X^{pj} + \Sigma_k a^{bik} Y_k + a_{ig} X_g + \mu_i X_i$$

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6 See Ambica Ghosh, "Income distribution and the structure of production," South Asia, New Delhi.

7 This simplifying assumption can be seen as a variant of the Kaleckian hypothesis that wage-earners (and naturally subsistence producers) do not save with the result that the flow from the factor of labour would go into consumption expenditure and not in investment. Induced investment would then result mainly from returns to capital

$Y_k = \Sigma a_{jk} X^{p_j} + \Sigma_j a_{jk} Y_j$
$M = \Sigma_j m_j X^{p_j} + \Sigma k_j$

where:

$a^{p_{ij}}$ are the input-coefficients of production sectors, $a^{h_{ik}}$ are the coefficients related to earnings of different income classes.

a_{ik} are value added proportions in gross output and a_{jk} are coefficients for income transfers among institutions.

a_{ig} are coefficients relating to government taxation on output as well as production subsidies.

μ_i is a policy parameter to determine exports of sectors as a proportion of the gross value of domestic products and services.

m_j is the coefficient for non-competitive imports in sector j.

k_j are competitive imports in sector j whose size is to be determined by a trade policy.

X_d is the total government revenue.

To the above defined "current accounts" model must be added the macro-balances on investment and savings, the trade balance and the government revenue and expenditure balances. Then as in traditional open Leontif solutions, the model can be simulated under various policy alternatives with regard to the real sector from the following general formulation:

$(I-A^*)^{-1} F_d = X_d$

where:

A^* is an augmented matrix of technical coefficients containing both consumption and production coefficients but excluding investment.

F_d is the desired final demand structure.

X_d is the desired structure of gross output.

To deal with prices in the model the dual of the matrix is derived from the primal giving the prices, the wages, the unit cost of government services and the shadow cost of the balance of trade. The dual form is outlined as below:

$$P_i = \Sigma P_j \; a^p_{ji} + \Sigma w_k \; a^h_{ki} + P^g_i . a^g_m + e\,[(k_i / x_i + m_i)\, P_{iw}]$$

$$P^e = \Sigma \mu_i \; P_i + \mu_k \; w_k + \mu_k a_{kg}$$

$$eP_m = \Sigma_i \; \Phi_i P_{iw}$$

The first set of equations gives the cost components in different sectors including unit profit and unit tax as equal to prices of the good in the sector.

The second set of equations gives the weighted costs of producing each export as equal to the unit price of export. The third set of equations gives the world price of different sector imports along with taxes by government as equal to unit price of imports.

Further the primal and its dual have to be linked with the financial balance of the overall economy. For this, there is need for a fiscal sub-model consisting of the financial balance in which the balance of trade, government surplus or deficit will have to enter along with money creation and net foreign borrowing as well as interest earnings or payments and the exchange rate which equilibrates the traded-goods sector.

2.3 Size of the model

The size of the model constructed for a country on the basis of the above model-type will naturally depend on the degree of disaggregation. Overall, the number of equations are n_1 productive sectors, n_2 household classes, one government sector and one foreign trade sector which together are equal to $n_1 + n_2 + 2$. The number of duals are equivalent and thus the primal and dual sectors together total to $2(n_1 + n_2 + 2)$ equations.

The number of variables are, n_1 product variables, n_2 income variables, one government income variable, one total foreign trade variable, the exchange rate, k_i import variables with $i = n_1 + n_2 + 1$ and S_i the difference between the total products and its delivery to all sectors (i.e. stock formation in sector i). For the dual variables there are again $n_1 + n_2 + 2$ price variables.

The policy variables may be selected with a base matrix on hand by preparing shifts on the products (X_i), the incomes (Y_k), the government incomes and the government expenditures. Direct and indirect taxes may be fixed along with an appropriate set of prices (P_j), outputs (X_i), the shadow prices of stocks (S_i) or savings to study the impact of the policy package on the unknowns of the system.

For the policy analysis of AAF-SAP at the country level it should first be reiterated that, as explained before, a large number of the coefficients are imputed to facilitate policy simulation. Thus in the actual application, the exercise is to start with the two base period matrices and their financial equilibration. This is followed by imposing certain changes in production and consumption sectors or in government taxation and expenditure sectors and some admissible limits in the balance of payments or government budget. Then the consequences are worked out through the entire model in respect of the changes that are imposed on the other variables and in the financial

sector and examine their feasibility. If found infeasible through suitable counteracting changes in the policy package the variables are shifted more nearly to the feasible limit in a process of iteration to approximate convergence.

In a more refined version of the model the specific limits to primary resources and labour of various skills and equipments in the short-run can also be incorporated in order to bring out the specific limitations for different countries due to the limits and to the tempo of structural adjustment with transformation.

It should be clear that the presentation of the model-type has been along structural parameters and policy variable used in a general equilibrium model in a "Balance Method" except for the technical coefficients which mildly introduce an element of production functions. However, some checking systems of a partial type can be easily introduced to bring parts of the model into the purview of market focus.

2.4 Some limitations of the extended input-output model-type

The present model has two limitations as outlined below:

a) The input-output coefficients, the allocation coefficients as well as the import coefficients are based on one point estimates as in the standard input-output analysis. Wherever possible, therefore, some checks in disaggregated or aggregated macro-models in one or more equations may be constructed as checks. Thus the correction factor for consumption coefficients by using historical income and family budget data may be used to update the consumption coefficients. The price elasticities may also be checked out in a similar way. Similarly historical data for capital and labour using econometric models of the Cobb-Douglas or C.E.S type may be used in disaggregated or aggregated form for the correction of the import coefficient data. The allocation structure of the necessary goods in consumption sector and the requisite subsidies may be checked by budget analysis and other studies. The export demand from the rest of the world may have to be checked against the world trend and the share countries have in the total export.

b) The Dynamisation of the model-type and the lines along which it may be done is an even more difficult and complex question. The interaction of variables like land, water availability and probability of draught etc. may have to be treated in a broad canvas introducing these coefficients in a suitable model of a much longer-time span. The methodology of this is not available in neo-classical market clearing mechanism and has to be developed theoretically and gradually extended to individual countries of Africa for the policy implication of such basic constraints. The model-type outlined in this section, being only a passive framework for accounting, must be strengthened by such auxiliary back-up systems, both political, social and economic.

2.5 Alternative Applications of the Model-Type to a "Core" Transformation Strategy

It is possible to tailor the model-type outlined above to alternative transformation strategies. In this section a "core" transformation strategy which draws from the experience of India is briefly discussed in relation to the model-type.

In the Second Five Year Plan in India a very wide range of policy options were taken up and this after about a year's working out was found to be operationally not

tenable. Under such a situation policy makers opted for a "core" strategy which involved giving special priority to some sectors while the others remained more or less on their historical trend movements. This transformation strategy seems very applicable to the AAF-SAP central theme of adjustment with transformation and below, the use of the model-type to analyse such a strategy is discussed. For simplicity only four production sectors are assumed plus a sector each for income groups, government and the rest of the world.

Assume that the core transformation policy is to replace gross output in sector X_2 by $(1 + d_2) X_2$ and sector X_3 by $(1 + d_3) X_2$ where d_2 and d_3 would denote the hypothetical increment of domestic production of X_2 and X_3. For example a decision could be made that a twenty percent increase (i.e. $d_2 = d_3 = 0.2$) will have to be achieved in a specified period of time.

We now rewrite the model as follows for the plan period

$$X_1 = a_{11} X_1 + a_{12} X_2 (1+d_2) + a_{13} X_3 (1+d_3) + E_1 + \delta S_1$$

$$(1+d_2) X_2 = a_{21} X_1 + a_{22} (1+d_2) X_2 + (1+d_3) X_3 + E_2 + \delta S_2$$

$$(1+d_3) X_3 = a_{31} X_1 + a_{32} (1+d_2) X_2 + a_{33} (1+d_3) X_3 + E_3 + \delta S_3$$

$$X_4 = a_{41} X_1 + a_{42} (1+d_2) X_2 + a_{43} (+d_3) X_3 + E_4 + \delta S_4$$

$$X_5 = a_{51} X + a_{52} (1+d_2) X_2 + a_{53} (1+d_3) X_3 + E_5 + \delta S_5$$

$$X_6 = a_{61} X_1 + a_{62} (1+d_2) X_2 + a_{63} (1+d_3) X_3 + E_6 + \delta S_6$$

$$X_7 = a_{71} X_1 + a_{72} (1+d_2) X_2 + a_{73} (1+d_3) X_3 + E_7 + \delta S_7$$

It is to be noted that only the 2nd and 3rd sectors have been changed as a matter of policy. The consequential change has gone into the inputs as technically determined or where relevant as policy determined. Computation is then carried out for the first or second order interactions.

On the delivery side the increased output $d_2 X_2$ and $d_3 X_3$ is routed as a first option to the domestic consumption sectors, without being balanced by reduction of imports so that consumption is increased without reduction of imports. The transformation policy thus seeks to increase domestic output and pass it on to the consumers without affecting imports. The consequence of this transformation can then be worked out.

The exercise, however, has still to go on into the basic factors involved in this increase, e.g. land, equipments, trained labour, the technology to be adopted etc. For each of these, auxiliary production function may have to be set up depending on the choice of the production function.

By using a simple input-output format the focus is mainly on the macro-balances of the economy. For capital, land etc. the two forms usually taken up in production function estimation are the Cobb-Douglas form or the C.E.S. function.

For the major sectors one may then form the production function for the ith sector either in the form

$$X_i = a_i . (L_i)^{\alpha_i} . (k_i)^{\beta_i}$$

With or without the usual restriction $\alpha_1 + \delta_1 = 1$. The corresponding form for the C.E.S. Production function will be

$$X_1 = \alpha_1 (\delta_1 L^{-F} + (1-\delta_1) K^{-F})^{-1/F}$$

Where α is the efficiency, δ is the input efficiency and F is the substitution parameter, L and K are labour and capital.

It is suggested at this stage that one should go for the simpler Cobb-Douglas type of function fitting of major sectors which are to be transformed and to see that the resource constraint on land or labour or capital is not violated by the proposed transformation. But this part will obviously need some amount of research into sectoral production functions. It is suggested, therefore, that a sub-matrix of restraint should be set up in the form of limits on capital, labour, land etc. for the major sectors and a physical resource balance drawn up using proposed targets in a production function to check the feasibility of the limits.

One may thus easily see that the ramifications of a change even in only two sectors necessitates a whole array of changes which are assessed either through past series or through technical experience of workers or managers in other sectors. If these changes are to put any restraint on the magnitude of the increase absolutely, then such restraints will have to be considered. Suppose there is no arable land available at all, then, obviously, the question of reducing land in other agricultural sectors and its consequences has to be brought into the picture.

Overall the point to observe is that a model-type based on social accounting matrix (SAM) can only provide the broad-based framework for balances. Specific macro-economic equations have to be set up as auxiliary equations which will eventually help to supplement the SAM framework.

Also it must be borne in mind that by its nature, a very detailed SAM is difficult to build up numerically. The practical way would be to construct a moderate sized SAM and depending on policy needs to set up auxiliary equations for each of the changes and its consequences.

Finally, it must be re-emphasised that detailed modelling of AAF-SAP is essentially country specific and resource specific in every sense. Each country has to consider its resources and decide on the core strategy for that country. The tempo at which the strategy is to be carried out depends to some extent on detailed modelling exercise with specific preferred changes to anticipate the stresses and strains in the various sectors that will have to be accepted to carry out the new strategic change in the economic and social milieu of the country.

PART III: TOWARD AN AAF-SAP GENERAL EQUILIBRIUM MODEL (AAF-SAP-GEM): SOME CONSIDERATIONS

3.1 Background Considerations for an AAF-SAP-GEM

It should first be noted that since AAF-SAP embraces multiple-objective and multiple-instrument programmes, the ideal and effective analytical and evaluation tool for such programmes would be an economy-wide general equilibrium model. Further, since the central theme of AAF-SAP is that of adjustment with transformation, it is evident that there is need for the model to have the capacity to deal with the adjustment dynamics in the long-term.

Secondly for any multi-objective programme with multiple-instruments, there is need to ascertain the nature and magnitudes of possible conflicts and trade-offs (in both the objectives and the instruments) and, as such a model to analyze AAF-SAP country programmes must facilitate experimentation with various combinations of objectives and policy packages along with the analysis of the time pattern of conflicts and trade-offs (i.e. the time pattern of structural transformation). Thus, the model should be able to simulate both the effects of a gradual adoption of policies (with possible gradual structural-parameter shifts) as well as those of a "shock" introduction of sets of policies.

Thirdly, AAF-SAP advocates the avoidance of a highly standardized and stylized approach to modelling the African economies. This is valid since, there are many different characteristics among the different economies of African countries. Indeed, experience tends to show that the transference of models from one country to another has rarely achieved the desired results because often, the objectives being pursued by one country and the policy-space available in such a country need not coincide with those in another country.

From the above three basic considerations emerges the most basic question: What type of comprehensive model incorporating the holistic and versatile approach of AAF-SAP can be proposed at the general non-country specific level. Of course, AAF-SAP recognized the importance of this question and therefore proposed a very flexible framework which gives "guiding posts" to be followed in the eventual elaboration of any country model. While the present effort is clearly intended to go a step beyond the framework proposed in AAF-SAP, it should be firmly kept in mind that the effort should not result in recommending a standard model for all African countries. Thus, what is presented in this section should be taken as further indicative steps that can assist individual countries to elaborate country-specific AAF-SAP-GEMs.

3.2 Piece-wise policy experimentation for an AAF-SAP general equilibrium model

Model builders are becoming increasingly aware of the fact that most implementable models "grow" slowly from a number of experimentation with separate studies of a number of relationships among sets of variables. Further, the reality of the paucity and unreliability of statistical data in Africa makes the approach of piece-wise policy experimentation more practical since data availability will impose specific limitations on what socio-economic relationships can be specified, estimated and simulated. In this section, some elements of the piece-wise approach to elaborating a general equilibrium model are outlined. These elements should be seen as building blocks which will lead to a full understanding of a number of relationships and transmissions of effects. The list of the elements should not be taken as exhaustive as the components are bound to change

among countries and overtime along a development path. Overall from the different groupings of the list as given below, manipulation points (where policy variables are explicitly introduced and manipulated) should be easily identifiable to anyone familiar with model-building.

(i) Taxes & Transfers

(a) Direct & Indirect Taxes, Transfer Payments
Changes in rates and/or transfers between sectors (changes in net sectoral terms of trade) or between income groups.

(b) Tax Reform
Increase in tax collection while reducing tax burden on the poorest segment of the economy (wage earner).

(c) Production Subsidies
By commodity & services.

(d) Interest Subsidy, Investment Tax Credit

(ii) Support of Agricultural Sector

(a) Food self-sufficiency
Changing land shares between food and export crops, changing relative prices between food and export crops, changing productivity levels.

(b) Agricultural Price Support
Exogenize price if it is determined in the domestic market and use foreign trade as the residual. If the price is determined in the world market, manipulate import tariff or export subsidy so as to support the target domestic price.

(c) Price Subsidy on Agricultural Products

(d) Public Capital in Agricultural Sector (or Public Works)
By increasing public new investment in agriculture or redistributing public capital stock into agricultural sector. (stock approach)

(e) Productivity (and Agricultural Production Technology)
Change time trend or a shift factor in production (or supply) function, introduce weather variable to capture effects of drought etc.

(iii) International Trade

Foreign sector policy experiments are proposed here assuming the existence of the following system.

- Exchange rate(s) can be endogenously determined or treated as exogenous.
- For the products whose prices are determined in the domestic market, fixed export share quota and import coefficients can be used.

- For the product whose price is determined in the world market, export-import volume is obtained as a residual in the domestic market clearing.

(a) Export Promotion

Changes in export quota, or export market share.
Price subsidy, export premium, and/or export subsidy.
Multiple exchange rates to promote specific products and/or sectors.
Increased public capital in export-oriented sectors.
By increasing public new investment into the relevant sectors or redistributing public capital stock into the sectors.

(b) Import Substitution

Changes in import quota.
Changes in import tariffs, import duties.
Multiple exchange rates to promote specific products and/or sectors
Increased public capital in import-substitution-supply sector.
By increasing public new investment into the relevant sector. (flow approach)
By increasing or redistributing public capital stock into the sector. (stock approach).

(c) Devaluation as a typical expenditure-switching policy:

Aim at evaluating the outcome of devaluation, whether it is expansionary or contractionary, as well as the sensitivity of the parameters in relation to it. These could include elasticity of export supply, of import demand, and of import substitution supply. The capacity to shift resources into the tradeable goods sector can also be investigated. Effects on shifts of income from wage earners to profit earners and other sectoral wage changes should be examined.

(d) Trade Liberalization

Complete or partial liberalization of trade, uniform tariffs in a subregional context (e.g. PTA), structured imports and changes in import levels etc.

(iv) Technology

(a) Substitution Possibilities

Experiment with changes in the elasticities of substitution by the use of CES production functions.

(b) Adoption of More Labor-Intensive Technology

Increase the labor share in the production functions.

(c) Upgrade Workforce

Manipulate the distribution of labor force by skill level exogenously, or install labor-skill distribution as a function of educational expenditure and other variables and manipulate on the determinants.

(v) Financial Sector: Credit Control, and Interest Policy

Experimentation in this area should focus on how the financial markets can be modeled into the system. However, for a financial market equilibrium, there are at least three schemes which have to be taken into account:

(a) Average borrowing cost is regulated and supply basically accommodates demand given the borrowing constraints on the different types of borrowers (firms, households, governments).

(b) Aggregate supply of loanable funds is fixed (i.e. given exogenously), and average borrowing cost is determined by the market demand-supply interplay in the absence of credit rationing.

(c) Both borrowing cost and loaned fund are determined through the process of market clearing.

Some other specific areas for experimentation include:

(a) Differential Effective Loan Rate across Sectors
e.g. putting a discount factor (less than one) on the rate (relative to the average lending rate) in the computation of implicit rental cost of capital for the firms under consideration.

(b) Across the Board Credit Squeeze
Increase the regulated nominal interest rate
Reduce the aggregate supply of loanable fund.

(c) Credit Rationing
Distribute a fixed supply of investable funds exogenously among sectors or firms.

In each of the above experiments, the influence on saving and investment interactions should be carefully examined.

Transfer of Ownership of Factors of Production

(a) Land Reform
Redistribution of land, specifically from large-scale farms to small-scale farms and effects on land, labour productivity, income distribution etc.

(b) Capital Stock Transfer (in Static Sense)
Change the distribution of capital among large-scale, medium-scale and small-scale firms.

Poverty and Income Distribution

In the context of properly evaluating the impact of different policy packages on the poor and vulnerable, it is important to undertake specific experiments in modelling the various transmission of policy effects to different categories of the population. Such experimentation could involve the concepts of the macro-economy (policies of adjustment and transformation), the meso-economy (involving the transmission process e.g. product and services markets, economic infrastructure and the social infrastructure) and the final impact on the micro-economy (households, and social classes e.g. women, children etc). Work along these lines is being undertaken by the World Bank in the context of the project on the Social Dimensions of Adjustment (SDA). However, individual African countries should start making their own piece-wise investigations in this area.

3.3 A schema of a general equilibrium model-type for AAF-SAP

As emphasized earlier, it is not intended here to develop a standard model to be applied to all African countries. However, what can be done is to present a schema that follows the AAF-SAP framework. This schema can be developed according to specific characteristics of a given country. The schema as presented here is tailored along the outline of the formalization of the AAF-SAP as given in the Annex of the published document E/ECA/CM.15/6/Rev.3. Thus the production functions are first defined, followed by the definition of income distribution among institutions and then the various gaps among the needs to be satisfied. Price equations are also introduced. As will emerge in the present section, the model schema fits closely within the structure of a social-accounting matrix.

(i) Production and Factors of Production

Output can be modelled as a function of two kinds of inputs:

(1) - factor resources such as labour (an aggregate of different skills, capital also an aggregate of different categories) and land. These factors are not produced during that period being simulated. (2) - intermediate goods.

In general, one can conceive these two kinds of inputs as substitutable among them. It is reasonable, however, to assume that, at least within one period, there is no substitution between the factor resources and the intermediary inputs, and that this substitution holds only between the elements of the first kind of inputs, mainly, between capital and labour. Substitution is also conceived to hold at the level of aggregation of some factors, such as between the different skills for the labour factor, and the different categories of capital. The intermediate inputs are assumed to be given by fixed input-output coefficient, IO(i,j).

The functional form that can be considered as general and flexible is the generalized CES function. This is form flexible enough to permit a wider specification of the technology in the different sectors. Depending on the values of the elasticity of substitution, the technology may correspond to one or other well known production functions, such as the Cobb-Douglas, or in the extreme case of zero elasticity to the Leontief fixed coefficient production function.

This is given as:

$$XD(i) = AD(i)[\mu_1(i).La_{agg}(i)^{\rho(i)} + \mu_2(i).Ka_{agg}(i)^{\rho(i)} + \mu_3(i).Tagg(i)^{\rho(i)}]^{-\delta_0(i)/\rho(i)}$$

Where $\mu_1(i)$, $\mu_2(i)$, $\mu_3(i)$ are parameters, ρ_i are the shares in the production functions, $\delta_0(i)$ is the elasticity of substitution with $\delta_0 = 1/(\rho-1)$.

$XD(i)$ is the domestic sectoral output. $AD(i)$ is a shift parameter and can be interpreted as reflecting disembodied technology. $AD(i)$ is a constant within a period and may be changed between periods to simulate for example weather uncertainty for the agricultural production function.

$Ka_{agg}(i)$ is the stock of aggregate capital goods assumed to be fixed by sectors within a period. A unit of sectoral capital stock is assumed to consist of fixed proportions of different investment goods (construction, machinery etc...) the proportions vary among sectors.

Lagg(I) is an aggregate of labour inputs.

Tagg(I) represent the aggregated land factor input which can be weighted by a quality index (depending on such factors as water, weather natural fertility, approximity of infrastructure etc...)

Factors aggregation

The sectoral labour input is an aggregation of different types of labour, differentiated by skills and other types. One can differentiate this also by institution: private/public, or by gender.

One can use a CES form for the labor aggregation. The particular Cobb-douglas form has been however, used in many studies and proved to be a good aggregation form.

$$Lagg(I) = \pi_{ss} L(I,ss)^{Ldist(ss,I)}$$

The Ldist (ss,I) represents the shares of different types of labour by skill in the aggregation function.

The capital aggregation is made up in the same way and the same can be applied to the aggregation of the land factor where the differentiating elements would be the quality of land (e.g. fertility and productivity characteristics etc...).

$$Kagg(I) = \pi_{kk} K(kk,I)^{kdist(kk,I)}$$

$$Tagg(I) = \pi_{tt} T(tt,I)^{tdist(tt,I)}$$

Demand for Factors of Production

In the traditional computable general equilibrium models, the demand for factors - labour and capital - is determined on the basis of the first order conditions of profit maximization. However, in the African situation, it seems best not to assume the neo-classical market clearing and deal rather with institutionally determined clearing structures.

For labour, the supply of labour in the different sectors can be formulated as a function of time while the demand for labour can be taken directly as a function of value added. The wage levels in different sectors can be taken also as a proportion of the value added from historical analysis of the components of value added. Capital requirements can be estimated directly from sectoral incremental capital-output ratios.

(ii) Income Distribution Block

From the production block outlined above, the model should proceed to the definition of income by different institutions. Essentially, three broad institutions should be catered for namely households, firms and government. These, however, can be disaggregated as desirable and if data permits. For example households could be disaggregated into rural and urban or into low, middle and high income levels. Firms could be disaggregated according to scale or in terms of formal and informal sectors. Below is a sketch of some general formulations for the income of different institutions.

Household Incomes

Households income comes from their respective shares in the factor incomes and also from transfers from the governments and outside. The mapping from factor income to household income in the model goes through obtaining first, the income of labor and capital rent etc. by skill and category, then, through the proportional shares of households in these factor categories.

The factors income by category can be directly aggregated as follows:

labor incomes by skills

$$LINC(ss) = \Sigma_I w(ss).L(I,ss)$$

capital incomes by sector

$$KINC(I) = PVA(I).XD(I) - \Sigma_{ss} w(ss).L(I,ss)$$

The total household income, can then be obtained by summation of factor income: the wage revenue coming from the share in labor employment (different skills), the share in the capital revenue (for those households which have a share in corporations) plus the share in the net transfers from government, and corporations plus international remittance.

Government Revenue

Government current revenue (net of subsidies) can be defined by the following general definitional equation.[8]

$$GR = TF - SUB + IT + DT + FBOR \cdot ER + KSE$$

where

TF = total revenue from import and export duties.
SUB = total subsidies
IT = indirect taxes
DT = direct taxes
FBOR = foreign receipts grants and borrowings
KSE = operating surplus from public and semi-public enterprises

(iii) Expenditure and the Satisfaction of Needs

Having defined the income distribution pattern among different categories of households and government, (revenue of firms can be taken as a residual), the expenditure levels as well as the degree to which specified needs can be satisfied (for the different income categories) are defined in a third block of equation as suggested in the

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8 Each component in the government revenue can, of course, be expanded into detailed equations to adequately reflect the possible structure of revenue and capture possible effects of different policies.

general formalized framework of AAF-SAP. Below is a schematic presentation of the formulation for expenditure levels and the satisfaction of needs.

Expenditure by Households

Bearing in mind the paucity of data on household consumption patterns in Africa (few African countries have completed household budget surveys), it is desirable to postulate relatively simple and straightforward formulations. Therefore, the general formulation given below can and should in practice be collapsed into more manageable relationships that accord with the quality and quantity of data available.

$$C(I,J) = Co(I)+[1-s(j)]YD(J).D(I,J)$$

where

C(I,J) = consumption of the product of sector I, by household category J.

Co(I) = minimum required consumption of output of sector I to satisfy a specified level of minimum needs for that output.

s(j) = marginal propensity to save by household category J.

YD(J) = disposable income for household category J.

D(I,J) = distribution parameter that allocates consumption outlays for the output of sector over and above the specified minimum for each category of households.

Government Consumption

To facilitate the analysis of different policy options on the government budget (e.g. the different concerns of AAF-SAP regarding increasing the expenditure on the social sectors or reducing the expenditures on the military) an allocative equation is proposed namely:

$$GC(I) = GC.DG(I)$$

where:

GC(I) = the different sectoral expenditures of government.

GC = total government expenditure that is determined exogenously taking into account revenues and the concerns of controlling the deficit.

DG(I) = distributional shares for government expenditures in the different sectors which would represent the policy choices.

Investment

To introduce the importance of investment as a major policy variable in the process of adjustment with transformation it seems logical to take it as exogenously determined. However, even in this context a number of various permutations need to be considered

to take account of the differing effects of different pattern of sectoral investment allocation as well as the role of the private sector or the informal sector. Different categories of investors could also be contemplated to distinguish for example, between foreign direct investment and internally induced domestic capital formation. The treatment of investment in the model along the general lines below could prove both realistic and analytically useful.

$$ITOT(I) = IG(I) + \Sigma_J IPRIV(I,J)$$

where

ITOT(J) = Total investment in sector I,

IG(I) = Government investment in sector i (exogenously determined)

IPRIV(I,J)= Private investment by type of investor J in sector I.

The treatment of Imports and Exports

In the treatment of imports, the "Armington"[9] formalization which has been used in many CGE Models and which has proved very useful in econometric estimation of import demand functions can be proposed.

The Armington function (CES) allows to treat a commodity as an aggregate across countries but specifies product differentiation by country of origin.

For each tradable commodity, an aggregate or composite commodity X(I) is defined as a CES function of two imperfect substitute elements: an imported commodity M(I) and a domestically produced and consumed commodity XXD(I).

Then we have the following formulation:

$$X(I) = AC(I).\{\delta(I).M(I)^{-pc(I)} + (1-\delta(I)XXD(I)^{-pc(I)}\}^{-1/pc(I)}$$

where $\delta(I)$ are parameters; AC(I) is the Armington shift parameter and $\sigma(I)$ is the elasticity of substitution between M(I) and XXD(I) with $\sigma = 1/(pc+1)$

Demand for imports

M(I) and XXD(I) can technically be looked at as like inputs in the composite goods X(I) and one can get the derived demand for M(I) and XXD(I) in the same way we get the derived factor inputs in a traditional production model, by minimizing the cost of the composite supply given the composite good aggregation function:

$$\{M(I)/XXD(I)\} = \{(\delta(I).PD(I)/(1-\delta(I)PM(I)\}^{1/(1+pc(I))}$$

Note that the demand for imports equation can be rewritten as

$$\{PM(I).M(I)\}/\{PD(I).XXD(I)\} = \{\delta(I)/1-\delta(I)\}\{\delta(I).PD(I)/(1-\delta(i).PM(I)\}^{\sigma(I)-1}$$

The Equation shows how, for any change in the relative price of imported goods, following an exchange rate policy or other exogenous shocks, the responsiveness of

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9 See Leamer and STERN's Book, Quantitative International Economics, Boston: Allyn and Bacon.

domestic demand depends on the level of the elasticity of substitution. If δ_i is close to zero,

$M(i)/(XXD(i))$ would be equal to $\beta(i)/(1-\delta(i)) = constant$

Thus any change in relative price does not affect directly the demand for imports.

In many developing countries, especially in the African continent, the elasticity of substitution is evidently low, in that, for both inputs and consumption goods, imports and domestically produced goods are rather complementary goods with elasticity of substitution nearing zero.

Furthermore, the import component in the composite X(i) is generally high and essential, both in the consumption side (basic goods) or in the production side (inputs)

The Treatment of Exports

The Demand for exports

Analytically the dollar price of a particular country's export PWE(i) depends on endogenous factors such as the domestic product costs, the exchange rate policy and export incentives.

$$PWE(i) = P(i)(1+TE(i))/ER$$

Where TE(i) is the export subsidy rate and ER is the exchange rate. In the treatment of the demand for exports, there is need to take into account some of the imperfect characters of the international market and the product differentiation by country of origin.

One generalization that can be tried is:[9]

$$E(i) = E_s(i)[n(i)/PWE(i)]^{\mu(i)}$$

where

$\mu(i)$ = the price elasticity of export demand.

$n(i)$ = an "aggregate" world price of product i reflecting a weighted average of costs and trade intervention in the world market for the good. $n(i)$ is normalized to 1. $n(i)$ can be taken as exogenous when the country is small, (i.e. when the country cannot influence the world price).

$E_s(i)$ = constant representing the country's market share when $n(i) = PWE(i)$

Any change on $n(i)$ or $PWE(i)$ following an external shock or an exchange rate policy will translate into an effect on $E(i)$. The intensity of this effect depends on the amplitude of $\mu(i)$. Changes on $PWE(i)$ may have non negligible effects on the world market share of certain goods. For an unchanged $PWE(i)$, it is not certain that a country can increase its share by only increasing production and it may be more realistic to view the world demand for exports as downward sloping.

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10 See F. de Melo, Dervis and Robinson (1982)

It should be noted that the parameter $\mu(I)$ has important implications. Sectors with $\mu(I)>1$ would be characterized as monopolistic sectors. Sectors with very high price elasticity of demand would be characterized as competitive export sectors. This will concern products characterized by an infinitely elastic international demand. Products with price elasticity demand nearing zero are those facing either one or other type of external or internal quotas.

The shares of exports E(I) in the domestic production XD(I), (domestic sales) and the share destined to the domestic consumption (XXD)(I) are derived from a constant elasticity of transformation (CET) function of exports and domestic sales.

$$XD(I) = AT(I)[\tau(I).E(I)^{\rho(I)} + (1-\tau(I)).XXD(I)^{\rho(I)}]^{1/\rho(I)} \quad \text{(CET)}$$

or

$$XD(I)=AT(I)[\tau(I).E(I)^{\rho(I)}+(1-\tau(I)).XXD(I)^{\rho(I)}]^{1/\rho(I)} \quad \text{(CET)}$$

For the sectors or commodities where exports are competitive with infinite export demand, (some agricultural commodities for small countries), the export supply is

$$[E(I)/XXD(I)] = [PE(I)/PD(I).(1-\mu(I))/\mu(I)]^{\sigma t} \quad \text{(EXP)}$$

where σt = elasticity of substitution between E(I) and XXD(I).

The introduction of Prices

1) Definition of domestic prices of imports

PM (I) = PWM(I)*ER*(1+TM(I)

where

PM (I) is the domestic price of import of goods

(I) PWM(I) is the world market price of imported good (I) (in dollars).

EF is the real exchange rate (CFA per dollar)

IM (I) is the tariff rate on import of good (I)

2) Definition of domestic export prices of export (composite goods).

PE (I) = PWE (I)*ER(1+TE(I)

where,

PWE (I) is the world price of good I (in dollars)

TE(I) is the export duty rate.

3) Value of domestic sales (absorption)

P(I)*X(I)=PD(I)*XXD(I)+PM(I)*M(I)

Where P(I) is the price of composite goods. The composite good definition and aggregation is explained next in the production equations block.

X(I) is the composite good (I) supply

PD(I) is the domestic price of good (i)

XXD(I) is the domestic sales of I(produced in the country)

4) Value of domestic output (sales)

PX(I).XD(I)=PD(I)*XXD(I)+PE(I)*E(I)

Where PX(I) is the average output price by sector I.

XD(I) is the domestic output by sector (I).

5) Value added price definition

PVA(I)=PX(I)*(1-(TAX(i)i - SUMJ.ID(I,J)*P(J))

Where ITAX is the indirect tax rate for sector I.

IO(I,J) is the input-output coefficient matrix.

If there are subsidies on inputs

P(J) in the equation is replaced by

(P(J) - inpsub(J)

6) Prices of capital goods

PK(I)=SUM(J, P(J)*IMAT(J,I)

Where PK(I) represents the rate of capital rent by sector I.

IMAT(J,I) is the capital composition matrix. As it is explained in the annex, reading down a column of this matrix, a row entry gives the fraction of the column sectors.

(d) Alternative closure rules for the Model

Below alternative closures are presented for the labor market, foreign exchange market and investment - saving gap. The choice of a specific closure has important effects on the analysis of the processes of accumulation, growth and income distribution. Closure rules also add new dimensions to the structuralist features represented in the core model through the substitutability (elasticities) between products and factors of production and to enable the introduction of the imperfect characteristics of some of the markets.

The labour market closure

Two alternatives closures are presented for the labour market, segmented with different categories (e.g. skills, rural/urban). In the first alternative, wages are fixed and firms are assumed to be on their demand curves of labor.

$$Wa(ss) = \bar{} W_a(ss)$$

In this case, both aggregate and sectoral employment are determined endogenously.

Of course, any theory specifying alternative empirical wage formation can be incorporated in the model such as that of partial adjustment to inflation where

$$w(ss) = W_o(ss).Pindex$$

Another less realistic alternative in the African context is that of a labor market clearing with an average wage adjusting to equate the aggregate labor supply and demand

$$\Sigma_I L(I,ss) = LS(ss)$$

Product market closure:

In the product markets, price regulation in some sectors, like the agricultural sector or some industrial subsectors can replace the market-clearing or mark-up pricing system. In that case, the price equation in the model is replaced by,

$$P(I) = P_o(I)$$

Excess supply and demand is then absorbed by exports or imports or by variation of stocks.

The Foreign Exchange Market Closure

There are here two alternative closures: The first alternative would assume the volume of foreign capital inflow and reflected as an exogenous value for the balance of trade deficit. In this case the equilibrating mechanism is provided by an endogenous variation in the real exchange rate determined as the relative price of tradable and non-tradables. Using an index of domestic prices (a CPI) a variation in the nominal exchange rate affects directly the ratio of the domestic price of imports and exports to that of domestic sales. A devaluation would raise this ratio, and would, if the elasticities permit induce both export substitution and import substitution. Here, the model, by "manipulating" the nominal rate relative to the domestic price index, determines the real exchange rate.

In the second alternative, the exchange rate is assumed fixed and the foreign capital inflow adjusts, with the balance of trade endogenously determined. There are two possibilities: (a) the price index is fixed exogenously, meaning that the real exchange rate is also fixed, and the balance of trade adjusts. (b) the aggregate price index is endogenously determined and the real exchange rate will change but not necessarily to adjust to clear the balance of trade.

The Saving-investment closure

In most of the models for developing countries the saving-investment equilibrium is best tackled through as investment-driven-type of closure. This is justified by the

active role and participation of government in the economy and important share it holds in total investment. Real aggregate investment in this closure is best treated as exogenously fixed. For the different closures, the savings and investment closure has a number of effects.

One such closure alternative that seems of interest in the context of AAF-SAP is what may be called a kalecki closure. In this closure prices are mark-up prices, based on prime costs of production. The level and structure of production are totally demand determined. At equilibrium, saving necessarily equalizes investment. The exchange rate is a real exchange rate, since the fixed mark-ups imply a fixed price index. An exchange rate variation generates a disequilibrium on the external market which, because of the fixed prices, can only be eliminated by either a compensation of foreign capital inflow or alternatively by various rationing schemes. Another closure alternative consists on a mix of the Keynisian and Kaleckian approaches and has been tried in a number of Latin American countries. In the structuralists models of these countries, the mix is implemented with flexible prices in some sectors (agricultural sectors) and mark-ups in the others.

ANNEX I

A Trial Application of one Model-Type

1. Introduction

In this annex an attempt is made to apply one of the model-types (presented in Part II) by analysing the economy of an African country with the use of the comprehensive framework of a Social Accounting Matrix by specifically focussing on whether adjustment policies have:

(a) improved the balance of payments,
(b) had effects on the structure of the economy or whether it has tied it firmly to export neglecting the growth of local skill and local self-reliance;
(c) succeeded in bringing the slightest change to extreme term of export dependence;
(d) brought about a better income distribution; and
(e) whether it is possible that alternative policy packages could have been possible to make the economy more self-reliant and less subject to excessive external dependence.

First, an overview of certain variables is presented to generally have an idea on the above questions. Secondly, an alternative policy strategy is tried out with partial modelling within a SAM.[11]

2. Overview of an economy

An analysis of the SAM referred to in the footnote and subsequent national accounts data brings out clearly several points which may be noted. A look at the SAM shows the following features in 1981:

(a) The balance of payment on the current and capital account together shows a deficit of $2164.7 million.[12] As an adjusting country the country has adopted policies so that its export increased along with imports. The balance of payment deficit was as follows -$290, $268, $1716, $1290, $1425 during the years 1984-1988. It has to be noted that the trade balance during the same period was -$522, -$411, $477 0 -$15, -$129. Thus a negative though declining trade balance was there while the capital account fluctuations added to the trade balance gave a favourable balance of payment.

(b) As far as the foreign sector is concerned the country in question is thus a strongly adjusting and successful economy, in the way approved by IMF or the World Bank. But an examination of the other aspects of importance to the economy such as reducing the heavy dependence on foreign trade both on the export side and the import side, are not very encouraging. The

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11 The SAM used throughout this annex is that prepared by ECA for the country for the year 1981.

12 The dollar figures used in this annex for this country do not correspond to the exchange rate of the country although the figures are proportionately equivalent.

following table shows the GDP at factor cost along with the export and import clarifying this observation.

Accounting Heads	$ million				
	1984	1985	1986	1987	1988
GDP	12050	13880	16405	18960	21065
Exports	5490	7018	9413	12034	14246
Imports	6494	8119	9199	13092	14820

From the table it is apparent that export has been on the whole over 50 per cent of GDP and increasing to about 60 per cent. The same may be said of imports.

The major export items and import items given below facilitate the elaboration of the heavy dependence of the country on foreign trade in one or two commodities.

Major Export items	1984	1985	1986	1987	1988
W	2523	2867	3553	4310	4677
X	249	178	104	90	79
Y	2151	2272	4951	6790	8527
Z	5066	6533	8918	11442	213661

The above table combined with the domestic production structure below has some very illuminating picture.

Sector	$ million				
	1984	1985	1986	1987	1988
Agriculture	1341	1492	1652	1882	1553
Manufacturing	1768	2038	2411	2761	3107
Construction)					
Electricity and)	2681	3051	3522	3940	9355
Water)					
Wholesale and)					
retail trade,)	2664	2787	3026	3428	3687
transport and)					
communication)					
Other services	3778	3917	4013	4135	4284

The local agriculture sector is languishing although manufacturing has improved. Trading has gone up again, mainly export-import oriented and services in government have remained almost constant.

Overall, it may be stated that the country in question has the following features:

(a) Its balance of payment position is on an improving trend and the economy is fairly liberal in the sense of international institutions.

(b) Its exports are tied to one or two commodities only, W and Y with Y having taken on a dramatic importance.

(c) It has high imports of food and other needs in substantial quantities.

(d) Most of the expansion over the years has gone along the lines of exporting one or two commodities and importing everything else, so that adjustment of the balance of payment has not moved with structural transformation. In fact, the instruments have all been geared mainly to adjustment of the balance of payment on its own.

However, it should be added that the country in question being small one with a small domestic market has so far done well by mainly concentrating on mono-culture exports and general import, but in the light of the SAF-SAP all the danger signals are there especially as regards the following:

(a) It is completely tied to foreign market in spite of the possibility it has to move substantially towards self-sufficiency in food, fishery and essential manufactures for the domestic market.

(b) In trying to cater to the export market its domestic investment and skill has mainly gone into export of products requiring low level of skills and even in this sector there has been no vertical integration, though the production of intermediate goods instead of just importing them and merely processing and assembling them.

(c) The country, in trying to cater to a tourist trade for a very sophisticated foreign population, has also concomitantly and substantially distorted its consumption pattern so that domestic skill is not geared to domestic consumption needs.

However, the reality of the country's economic situation is that if the authorities were suddenly to try to move at a fast tempo towards self-sufficiency in all areas the result would certainly be a chaotic failure as certain dislocations of the economy would be unsustainable. It is in this context that the alternative "core" of transformation strategy is being analysed below using the model-type proposed in Part II of the present paper.

3. Presentation of the Base structure of the Economy

This operational process will be initiated by defining a possible "core" in the path towards structural transformation. Let us assume that the core of the transformation will be the development of the food-crops and fishery sectors as the central policy.

In terms of the model, the following sectors are defined.

1. Export agriculture
2. Food-crops

3. Fishery and livestock
4. Mining and Mfg. sector
5. Labour, capital, households and enterprise
6. Government and financial services
7. Others
8. Foreign sector

In constructing a transaction matrix base on these sectors focus can be put on (1) food crops (2) fishery and livestock and follow through the interaction of these two sectors with other sectors. The condensation of the sector mainly emphasises the sectors of importance to the country and the impact of an initial transformation of the structure.

Table (1) gives the condensed version of the base-period SAM in 8 sectors and is denoted in future by X(0).

Table (2) gives the coefficient Matrix computed on X(0). It is to be noted that except the foreign sector (columnwise) all the others have been expressed as a proportion. It is obvious that coefficients relating to sector 1 to 4 are standard input-output type of technical coefficient. For the other sectors the following should be kept in mind:

(a) The expenses of any sector due to government charges is taken as a fixed proportion of its earnings. This is obviously arbitrary and the coefficients can be changed by policy prescriptions if felt necessary.

(b) The entire import has been taken to be non-competitive and a fixed proportion of total delivery. For the time being this is acceptable since the country under study does not produce what it consumes either finally or as intermediate product. But this is to be treated as a flexible coefficient as the economy changes so that imports may be partly taken as fixed and partly as a matter of policy.

(c) The sector comprising, labour, household and enterprise is really the combined "value added" sector and its further sub-division will be necessary later. It is assumed that final consumption from each sector by this sector is a fixed ratio of household income, somewhat like the consumption function.

(d) The set of consumption coefficients thus constructed may even in the short-run be treated flexibly with policy change. The coefficient form is maintained for manipulative operations only.

(e) The government expenditures are treated as proportions of government income although this is not quite realistic and the current coefficients may be amended corresponding to policy changes with subsequent government budgets.

(f) The exogenous column consists of exports and net capital formation sectorwise.

(g) The equation relating the coefficient matrix to total delivery is the standard input-output system namely: $AX+E+S=X$.
Where X are the total deliveries, E Exports and S the surplus or deficit when balanced against column total.

From the condensed table a further consolidation has been made in Table 3 in order to derive some macro variables like government expenditure, household savings, export-

import balance, by consolidating the capital and current transactions in the following sectors:

1. Household etc.
2. Govt. and Financial Services
3. Others
4. Foreign Sectors

From this table the following balance relations emerge.

Combining the current and capital a/c. we have household income as consisting of (factor) earnings from within households, earnings from government, earnings from manufacturing and other activities and earnings from rest of the world on current account along with net capital inflow into household from other sectors and foreign sources less the rate of interest on borrowed capital from other internal sectors plus the interest earning on capital advanced plus the net loans and advances from foreign and national sectors.

For Government and financial sectors the consolidated current and capital accounts go to government both from national and foreign sources less the net dividend and interest payment along with current earning of the Government through taxes and its expenses through purchases of goods and services.

It will be seen that the major balances including current and capital transaction show for households and government net deficit current and capital inflow is less than current and capital disbursements. In the rest of the World account the current and capital earnings of the Rest of the World is less than the earnings of the country as current and capital account together show a balance of payment in favour of the country.

Table 4 gives the matrix for temporarily equilibrating prices and costs for the base period where the typical sector equation shows the costs of internally processed material (in ratio) x price. The import coefficient would have to be multiplied by exchange rate and World Price to be equated to the price of the commodity. Thus, a typical cost price equation will be of the form, say for sector (2), below:

$$a_{22}P_1 + a_{22}P_2 + a_{32}P_3 + \ldots\ldots a_{m2}.e^{p}{}_{2w} = P_2$$

Where the $a_{1\,11s}$ are the columns of the coefficients matrix now forming a row (i.e. transpose) e is the exchange rate and P_{2w} is the world price of the imports into the sector from rest of the world.

Given the exchange rate in the base period this will relate local prices and world price in a single equation system. If the base period world prices are taken to be unity the price will be determined as function of the coefficient and the exchange rate. Any shift in the exchange rate, thus will shift relative prices, depending on the coefficients. The coefficient matrix is given in Table 4 below for the Base period.

4 .Application of the model-type to a "core" strategy analysis of the country's transformation

In applying the model-type for illustrative purposes a policy option of increasing output of food and diversifying exports is taken. For this purposes a target increasing the output of the sectors of food crops and of fisheries and livestock by 20 per cent is stipulated along the lines outlined in section 2.5 of the text. Thus as a matter of policy to achieve structural transformation only the second and third sectors are changed. Table 5 gives, after computations the new transaction flows resulting from the increase

of 20 per cent in the output of sectors 2 and 3 and the first order changes in inputs of other sectors due to the increase of the two sectors. Tables 5 to 8 give the changes due to the new transformation policy in the variables corresponding to Tables 2 to 4.

We shall briefly discuss the simulated approximate results of the transformation for the first option. In this option outputs of sectors 2 and 3 are increased by 20% and the resulting increase is allowed to flow into the consumption matrix without a corresponding cut in imports.

On consolidating the current and capital matrix with the change in the current matrix through the input output model table (6) shows that with a 20% change in output of sectors 2 and 3 there is an increase in household expenses and there are small rises in intermediate consumption in all the other sectors as a matrix multiplier effect (considered only in the first round). The overall negative imports through rest of the world slightly increase. By and large as these two sectors are small this transformation does not substantially change the SAM when both capital and current accounts are consolidated.

When we consider the second option of cutting down imports in sectors 2 and 3 as there has been an increase in domestic production, this leads to a decline in import flow in the household sector resulting in a cut down in imports in this sector which have been aggregated with other imports.

The demonstrations of Table (3), (5) and (10) thus show that for moderate changes in the flow matrix the overall results can be absorbed with marginal improvement either in household consumption or in imports.

It is to be noted that in this illustration we have not brought in the resultant changes in investment both imported and domestic which would be necessary to deal with the proposed 'core' changes. To do this, we have to follow up the increased output through a production function into the shift in capital either domestic or imported. As discussed earlier this is proposed to be done by using suitable production functions which have not been discussed in this paper as this will require rather more data than was available for the present exercise.

Coming to the these main closures of savings and investment, Government revenue and expenditure and import and export, the shifts may be noted from Table 3, Table 6 and Table 10.

In the 1st option of increased domestic production without cutting down imports, the household expenditure slightly increases so that savings decrease as increased production is diverted to expenditure though not fully compensated by household income.

The three summary sets of totals given in Table (3), (6) and (10) may be profitably compounded as below.

20% increase in price, 10%

Sectors Aggregated	Base Table		without cutting down imports		with cutting down imports	
	Income	Exp.	Income	Exp.	Income	Exp.
Household	15620.9	15158.3	16720.8	15258.1	16690.6	15148.5
Government	4417.0	4860.2	4434.8	4870.5	[illegible].9	4865.2
Rest of the world	4508.3	5021.9	4614.2	5132.3	4606.9	5558.0

The impact on the different macro-balances thus show an increase in household expenditure and government expenditure with an increase in outflows to the rest of the world in the 1st option. In the second option the household expenditure increases directly and outflows to the rest of the world declines resulting in an improved balance of payment position.

The simulated results of the possible second policy option are also presented in Tables 9 to 12 which correspond to Tables 1 to 4 for the base period and Tables 5 to 8 for the first option. In this option it is assumed that the increase due to extra production in sectors 2 and 3 is used not to substitute for food imports.

The above results thus illustrate in very simple terms the current macro balances and how they are changed by a policy option for some sectors considering only the current accounts. For a more complete picture this has to be pursued also in the capital matrix so that the overall picture of the economy due to changes in one or more sectors are deliberately brought about by shifting policy to transform the production structure.

As said before for a thorough examination country specific sectoral production functions however crude need to be brought into the picture. But for most simple economies this kind of approximate simulation can be carried out with comparative ease demonstrating the feasibility or otherwise in proposed changes without going into very complicated model formulation.

Table 1. The condensed Transaction Matrix of the base period (1981)

Export agriculture	39.4	2.3	24..	1495.8	-	2.7	-	-	1856.5	-
Food crops	-	4.0	-	19.0	136.0	0.7	-	8.7	171.4	-
Livestock and fishing	-	-	-	-	268.4	3.1	-	8.1	279.6	-
Mining and Mfg. sectors	113.7	8.8	1.1	482.8	1678.1	88.6	34..8	2122.3	4785.3	618.4
Lab. Cap. households.										
enterprises	991.7	127.7	127.0	2281.4	8722.4	2474.2	2136.7	88.0	17417.3	-428.4
Cost of Govt. and										
Financial services	11.4	-	18.2	62.9	2775.6	1285.6	216.4	428.6	4417.3	-
Others	177.7	8.3	27.4	372.9	2288.8	917.2	842.0	2447.2	5343.6	2380.3
R. W.	218.8	28.7	58.9	804.7	3257.7	272.7	-	-	3521.3	-
Total	1550.8	174.0	259.2	4599.8	16074.3	5661.7	3375.7	5086.9	37186.3	1570.0
Capital transaction	-	-	-	-	1870.7	-792.5	-	-	-	1078.2

Table 1: Coefficient Matrix of the Base Period

	1	2	3	4	5	6	7	8
Export agriculture	0.0287	0.001	0.030	0.1106	-	0.002	-	-
Food crops	-	0.053	-	0.0249	0.0078	0.00152	-	8.7
Livestock and fishery	-	-	-	-	0.0154	0.0110021	-	9.1
Lab. Cap. households. enterprises	0.6171	0.313	0.469	0.2911	0.5189	0.7910	0.4026	68.6
Cost of Govt. and Financial service	0.3073	-	0.370	0.11124	0.1413	0.091	0.0442	403.6
Others	0.1242	0.033	0.1101	0.0779	0.0673	0.0719	0.873	244.1
R.W.	0.1404	0.152	0.126	0.1693	0.1312	0.010854	-	-

Table 6: Revised Coefficient Matrix

Table 7: Capital and Current Account Consolidation

Lab. Coop. Households, enterprise	5710.4	3487.41	4880.61	-317.69	16752.73	
Cost. of Govt. and financial service		1075.6	1397.18	333.6	439.42	4401.81
Others		1144.7	614.0	3547.64	6388.61	16282.73
R. W.		4171.4	-927.67	4111.44	-	46.45.11
Total		10217.1	4976.61	11187.33	6673.69	40156.88

Table 8: Equilibrating Price Matrix of the policy on transformation

	1	2	3	4	5	6	7	8
1. Export agriculture	0.1167	-	-	0.0736	0.8271	0.0172	0.1241	0.1251
2. Food crops and fruits	0.071	0.1111	-	0.1251	0.1643	-	0.1111	0.1251
3. Livestock and fishing	0.251	-	-	0.1141	0.111	0.1171	0.1241	0.1171
4. Mining and mfg. sectors	0.1111	0.1041	-	0.1241	0.1211	0.1111	0.1171	0.1241
5. Loc. Cap. Goods:								
enterprise	-	0.1171	0.1111	0.1111	0.1211	0.1111	0.1171	0.1111
6. Cost of Govt.								
financial service	0.1111	0.1111111	0.1111111	0.1111	0.1111	0.1111	0.1111	0.1111111
7. Crowns	-	-		0.1111	0.1111	0.1111	0.1111	-

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Table 21: The Population Varies in Revised from the Uprint

Export Agriculture								
Food crops and fruits								
Livestock and Dairy								
Mining and manufacturing sectors								
Wth. Cap. Consertib. enterprises								
Cost of Govt. and financial service								
Others								
G.N.								

Table 10: Classification table format for system

1. Subject specialization											
2. Field issue and topics											
3. Livestock and feeding											
4. Within the ECA region											
sectors											
5. User type categories											
enterprise											
6. Cost of user											
financial software											
7. Others											